COLLEGE OF ENGINEERING
DEPARTMENT OF MECHANICAL ENGINEERING
MEEN 4303: AERODYNAMICS, 001, 3, IN-PERSON

ENGC 113
Fall 2025

INSTRUCTOR INFORMATION

Instructor: Arturo Rodriguez, Assistant Professor
Office Location: Engineering Complex 215
Face-to-Face Student Support Hours: MW 9:00 AM - 10:00 AM
Office Phone: (361) 593 - 2628
Office Fax: TBD
University Email Address: arturo.rodriguez@tamuk.edu
Course Mode of Instruction: Face-to-Face
Preferred Form of Communication: Student Support Hours

COURSE DESCRIPTION

MEEN 4303 is a course about aerodynamics, i.e., the study of the flow of air about a body. In our case, the body will be an airplane, but much of the aerodynamics in this course is relevant to a wide variety of applications, from sailboats to automobiles to birds. MEEN 4303 has a set of learning objectives that you should always keep in your thoughts as the semester progresses. The entire course is structured to help you achieve these objectives. Specifically, students graduating from MEEN 4303 will be able to:

- Formulate and apply appropriate aerodynamic models to predict the forces on and performance of realistic three-dimensional configurations.
- Assess the applicability of aerodynamic models to predict the forces on and performance of realistic three-dimensional configurations, and estimate the errors resulting from their application.
- Perform a computational and experimental aerodynamic analysis and design together with members of a team.

COURSE INFORMATION

- Textbooks | Not required
    - John D. Anderson, *Fundamentals of Aerodynamics*, 7th Ed.
    - John D. Anderson, *Introduction to Flight,* 9th Ed.
- Online Resources
    - MIT Aerodynamics OpenCourseWare, 16.100 | Fall 2005 | Undergraduate
    - MITx Introduction to Aerodynamics, 16.101x
    - Aerodynamic CFD, Aerodynamics Course, MIT, Prof. Qiqi Wang
- Software
    - Python (Google Colab), XFOIL in MATLAB, ANSYS Fluent

STUDENT LEARNER OUTCOMES

Upon successful completion of this course, students will be able to:

1. Apply flow similarity, non-dimensional coefficients such as the lift and drag coefficients, and non-dimensional parameters such as the Mach number and Reynolds number in aerodynamic modeling of realistic configurations.

2. Apply integral momentum conservation and streamline curvature arguments to explain the relationships between flow turning, the generation of lift on an airfoil, and the subsequent loss of lift upon stall.

3. Explain the sources of friction, induced, wave, and pressure drag.

4. Explain the motion and deformation of a fluid element using kinematics, including the definition of shear strain, normal strain, vorticity, divergence, and the substantial derivative.

5. (a) Explain the concept of a laminar boundary layer, including the definition of the displacement thickness, the momentum thickness, and the skin friction coefficient, and the importance of the Reynolds number in determining the presence and behavior of a boundary layer (homework, exams), and (b) Apply the integral boundary layer equations to describe the qualitative evolution of a laminar boundary layer including separation and to estimate the local thickness and skin friction quantitatively.

6. Explain the onset of turbulence in a boundary layer (i.e., transition) and the qualitative effects of turbulence on boundary layer evolution, including the impact on velocity profile, skin friction coefficient, boundary layer thickness, and separation.

7. Estimate the friction drag on 2-D and 3-D configurations by decomposing the geometry into patches and assuming appropriate local values of skin friction coefficients, including the possibility of laminar or turbulent boundary layer conditions.

8. Explain the basic elements of 2-D panel methods and 3-D vortex lattice methods.

9. Explain the basic elements of coupled inviscid-viscous models for 2-D airfoils.

10. Explain the basic elements of thin airfoil potential flow models to estimate the forces on airfoils

in 2-D subsonic and supersonic flows. Apply a thin airfoil potential flow model to estimate the forces on airfoils in 2-D subsonic and supersonic flows.

11. Explain the basic elements of the lifting line model for high aspect ratio wings. Describe the dependence of lift and induced drag on geometry and performance parameters (e.g., aspect ratio, twist, camber distribution, wing loading, flight speed, etc.) using the lifting line model. Apply the lifting line model to estimate lift, induced drag, and roll moments on high-aspect-ratio wings.

12. Explain the basic elements of the finite volume approximation to the compressible Euler and Navier-Stokes equations.

13. Explain the relationship between sound propagation and shock waves. Describe the qualitative change in flow conditions (Mach number, pressure, temperature, total pressure, etc.) across shocks and expansion fans. Estimate the change in flow conditions across shocks and expansion fans using shock-expansion theory. Explain the transonic drag rise, including the critical Mach number and the use of wing sweep to delay drag rise.

14. Explain the use of wind tunnel testing in aerodynamic modeling, focusing on the importance of flow similarity in scale testing and on the typical corrections (e.g., wall corrections) required to simulate flight conditions.

15. Assess the ability and limitations of an aerodynamic model to estimate lift and drag (separated into friction, induced, wave, and pressure drag contributions) for a specific application.

16. Contribute substantially as an individual to the design and execution of a computational and experimental aerodynamic analysis of a realistic 3-D configuration, together with members of a team.

BASIC ELEMENTS

The basic elements of a model include the critical features that produce a valuable predictive method. For example, consider a 2-D panel method. The fundamental elements would consist of: all of the underlying assumptions of incompressible, potential flow; the discretization of an airfoil geometry into a set of line segments on which potential flow solutions are distributed; and the satisfaction of flow tangency at panel control points. The global influence of an individual panel on all other panels; the imposition of the Kutta condition; etc. However, the basic elements would not include the more detailed aspects of the method, which, while important, are not critical to understanding how the technique works. In the 2-D panel method example, it would not include the details of the calculation of the influence coefficient of a general source/vortex/doublet panel, the solution of the extensive linear system of equations, etc.

GENERAL PEDAGOGY AND ASSESSMENT STRATEGY

The skills to be gained in this course are basically of three types:

- Quantitative or Analytical Skills
- Qualitative or Conceptual Skills
- Integrative Skills

For each skill, a different pedagogical and assessment strategy is used. Analytical skills are taught and/or assessed through the textbook reading, homework assignments, the written exams, and, to a lesser extent, the team project. Conceptual skills are taught and/or assessed through in-class conceptual questions, the oral exams, and, to a lesser extent, the project and the written exams.

GRADING

Assessment Mode	Description	Weight
Exams	Midterm and Final	30%
Project	Proposal, Final Presentation, and Final Report, Groups of Five	30%
In-class Exercises	Come to Class and Ask Questions, Groups of Five	20%
Homework	Groups of Five	20%

Grading Scale

A = 90% - 100%
B = 80% - 89%
C = 70% - 79%
D = 60% - 69%
F = 59% or below

Late submissions without prior approval will not be accepted.

COURSE SCHEDULE

This schedule aligns with core mechanical engineering applications and progressively builds from foundational topics to hands-on modeling and deployment.

DISCLAIMER – The schedule for the Topics mentioned below may change depending on the progress made in the class.

Course Schedule: Assignments

Week	Assignments / Activities
1 | 08/20/2025 - 08/22/2025	
2 | 08/25/2025 - 08/29/2025	Homework 1
3 | 09/01/2025 - 09/05/2025	Homework 2
4 | 09/08/2025 - 09/12/2025	
5 | 09/15/2025 - 09/19/2025	Homework 3
6 | 09/22/2025 - 09/26/2025	Proposal Presentation
7 | 09/29/2025 - 10/03/2025	Homework 4
8 | 10/06/2025 - 10/10/2025	
9 | 10/13/2025 - 10/17/2025	

10 | 10/20/2025 - 10/24/2025

11 | 10/27/2025 - 10/31/2025 Homework 5

12 | 11/03/2025 - 11/07/2025

13 | 11/10/2025 - 11/14/2025 Homework 6

14 | 11/17/2025 - 11/21/2025

15 | 11/24/2025 - 11/28/2025

16 | 12/01/2025 - 12/05/2025 Final Presentation and Final Report

NOTES:

- **IN-CLASS EXERCISES, PLEASE COME TO CLASS AND ASK QUESTIONS, EVERY CLASS**

COURSE AND UNIVERSITY PROCEDURES/POLICIES

INSTRUCTOR'S POLICIES

Attendance

Attendance is crucial. Students with six or more absences may be dropped from the class, which could negatively impact financial aid or other programs. The instructor may take attendance or use classwork to count toward attendance. Any attendance-related issues must be resolved within two weeks of notification. Failure to adhere to the attendance policy may result in a withdrawal from the course with a "WF" designation if the student fails during the drop.

Late/Missing Work/Extra Credit

Late submissions are prohibited; students must submit assignments by the specified deadlines. There is no provision for makeup exams; missing an exam without a university-approved excuse could result in a zero for that assessment. However, extra credit opportunities are available through participation in specific coding challenges, projects, or other bonus activities designated by the instructor. Students are encouraged to use these opportunities to enhance their understanding and improve their final grades.

Other Course Policies
Other policies include strict guidelines on academic integrity and classroom behavior. Scholastic dishonesty, such as cheating or presenting someone else's work as your own, is taken very seriously and will result in disciplinary action, including possible course failure. Electronic devices are prohibited unless explicitly allowed during exams, and any violation may lead to a zero on the exam and further academic penalties. The course also enforces a zero-tolerance policy for harassment, which includes persistent inquiries about grades or administrative decisions and any form of disruptive behavior in the classroom. Additionally, students may be required to present their ID during exams and may be required to sign in. Accommodations are available for students with disabilities; discussing these needs with the instructor as early as possible is advised.

Use of AI in the Classroom
AI tools (such as ChatGPT) are welcome in this class, provided you properly cite when and how you use the tool. Using an AI tool to generate content without proper attribution violates the University's academic misconduct policy and may lead to disciplinary procedures.

UNIVERSITY POLICIES

Six Drop Policy
The following provision does not apply to students with Texas public college or university credits before Fall 2007. The Texas Senate Bill 1231 specifies the number of course drops allowed to a student without penalty. After a student has dropped six courses, a QF grade will generally be recorded for each subsequent drop. Additional information on Senate Bill 1231 is available at the Registrar's Office at (361) 593-2811 and Academic Procedure: Drop Policy.

Students with Disabilities
The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. This legislation requires that all students with disabilities be guaranteed a learning environment that provides reasonable accommodations for their disability. If you believe you have a disability requiring an accommodation, please contact the Disability Resource Center (DRC) as early as possible in the term at (361) 593-3024. DRC is located in the Student Health and Wellness building at 1210 N. Retama St.

Classroom Conduct Expectations
Students are referred to the *Student Code of Conduct* section of the Student Handbook. Students are expected to assume individual responsibility for maintaining a productive learning environment and conduct themselves with the highest regard for the response and consideration of others. Ongoing or single behaviors considered distracting will be addressed by the faculty member initially, but if the behavior becomes excessive and the student refuses to respond to the faculty member's efforts, the issue will be referred to the Dean of Students. In the case of serious disruptive behavior in a classroom, the instructor will first request compliance from the student, and if the student fails to comply, the instructor has the authority to ask the student to leave the classroom. The student is expected to comply with the instructor's request and may subsequently contest this action using procedures established by the department. If the student fails to leave after being directed to do so, assistance may be obtained from other university personnel, including the University Police Department. The incident shall be handled as an academic misconduct matter using established departmental procedures for academic misconduct to determine if the student should be allowed to return to the classroom.

Academic Misconduct

Students are expected to adhere to the highest academic standards of behavior and personal conduct in this course and all other courses. Students who engage in academic misconduct are subject to the University's disciplinary procedures. Students are expected to be familiar with the current Student Handbook, especially the section on academic misconduct, which discusses conduct expectations and academic dishonesty rules. Academic dishonesty includes but is not limited to:

1. Cheating: deception in which the student misrepresents that he/she has mastered information on an academic exercise that he/she has not mastered; giving or receiving aid unauthorized by the professor on assignments or examinations.
2. Aid of academic dishonesty: Intentionally facilitating any act of academic dishonesty. Tampering with grades or taking part in obtaining or distributing any part of a scheduled test.
3. Fabrication: use of invented information or falsified research.
4. Plagiarism: unacknowledged quotation, and/or paraphrase of someone else's work, ideas, or data as one's own in work submitted for credit. Failure to identify and submit information or essays from the internet as one's own work also constitutes plagiarism. Please be aware that the University subscribes to the Turnitin plagiarism detection service. Your paper may be submitted to this service at the instructor's discretion.
5. Lying: deliberate falsification intending to deceive in written or verbal form, as it applies to an academic submission.
6. Bribery: providing, offering, or taking rewards in exchange for a grade, an assignment, or the aid of academic dishonesty.
7. Threat: an attempt to intimidate a student, staff or faculty member for the purpose of receiving an unearned grade or in an effort to prevent reporting of an Honor Code violation.

Other forms of academic misconduct included but are not limited to:

1. Failure to follow published departmental guidelines, professor's syllabi, and other posted academic policies in place for the orderly and efficient instruction of classes, including laboratories, and use of academic resource or equipment.
2. Unauthorized possession of examinations, reserved library materials, laboratory materials or other course related materials.
3. Failure to follow the instructor or proctor's test-taking instructions, including but not limited to not setting aside notes, books or study guides while the test is in progress, failing to sit in designated locations and/or leaving the classroom/test site without permission during a test.
4. Prevention of the convening, continuation or orderly conduct of any class, lab or class activity. Engaging in conduct that interferes with or disrupts university teaching, research or class activities such as making loud and distracting noises, repeatedly answering cell phones/text messaging or allowing pagers to beep, exhibiting erratic or irrational behavior, persisting in speaking without being recognized, repeatedly leaving and entering the classroom or test site without authorization, and making physical threats or verbal insults to the faculty member, or other students and staff.
5. Falsification of student transcript or other academic records; or unauthorized access to academic computer records.
6. Nondisclosure or misrepresentation in filling out applications of other university records.
7. Any action which may be deemed as unprofessional or inappropriate in the professional community of the discipline being studied.

Harassment/Discrimination
Texas A&M University-Kingsville does not tolerate discrimination on the basis of race, color, religion, national origin, age, disability, genetic information, gender, gender identify or sexual orientation (or any other illegal basis) and investigative processes are available for any reports that indicate sexual harassment, sex-based misconduct, harassment, or discrimination may have occurred by a respondent that has enrolled at or is employed with the university. Sexual harassment, sexual assault, dating violence, domestic violence, and stalking based on sex are types of sex discrimination. Such sexual misconduct is unacceptable and will not be tolerated. Any member of the university community violating this policy will be subject to disciplinary action. A person who believes they have been the victim of sexual harassment, sexual assault, dating violence, domestic violence, stalking based on sex or unlawful discrimination of a protected class may pursue either the informal or the formal complaint resolution processes. Reports may be initiated with the Office of Compliance at (361) 593-4758, with the complainant's immediate supervisor, a department head, a supervisory employee, any faculty or staff, or the Dean of Students at (361) 593-3606. Regardless of who the incident is reported to, the Compliance Office will be notified of the report so that they can reach out to the complainant to discuss supportive measures and administrative processes that may be available.

Please note, all faculty and staff are mandated reporters, except for counselors at Student Health and Wellness. Counselors at Student Health and Wellness are confidential reporters and will not disclose any identifiable information regarding an incident that is made known to them. However, they may be able to provide information on where supportive measures can be obtained and administrative processes initiated. A mandated reporter (any faculty and staff) is required to report any incident that is made known to them, while they are working within their job description, to the Office of Compliance, Lewis Hall, Suite 130, 361-593-4758, titleix@tamuk.edu. This includes incidents that have occurred on or off-campus. For those who wish to remain anonymous and are not reporting a mandated report, anonymous reporting is available at https://secure.ethicspoint.com/domain/media/en/gui/19681/index.html.

Pregnant and Parenting Students
Texas A&M University-Kingsville does not tolerate discrimination of pregnant or parenting students. Students who are pregnant or parenting may not be denied access to any program or activity on the basis of their pregnant or parenting status. Any pregnant students, or student planning on becoming pregnant, should consult their health care provider to determine what, if any, accommodations are needed, based on their individual situation. Temporary leave for pregnant or parenting students due to medical necessity may also be available. It is the responsibility of the student to communicate their needs to the faculty member or Office of Compliance as soon as possible in order for risk-reduction to be assessed and to determine if additional modifications for the course are necessary. While the university cannot mandate the disclosure of a student's status as pregnant or parenting, the university strongly recommends that students do provide notification, so appropriate steps can be taken to ensure the health of both the parent and child. To communicate health circumstances or to request additional information (accommodations, leave, lactation rooms, pregnancy parking permits, etc.), the following individuals may be contacted:

Pregnant Students:
Tasha Clark, Office of Compliance, Lewis Hall, Suite 130, 361-593-4758, TitleIX@tamuk.edu

Parenting Students:

Kirsten Company, Office of the Dean of Students, MSUB, RM 306, 361-593-3606, Kirsten.company@tamuk.edu

UNIVERSITY SUPPORT SERVICES

NAME	SERVICES	
Pathways Academic Assistance Center	• Tutoring and academic support, in-person and online • Peer Tutors help provide a solid academic foundation that enables students to become confident, capable, independent learners • Tutors guide students in identifying, acquiring, and enhancing the knowledge, skills, and attitudes needed to reach their desired goals	Location: Jernigan Library, 220 Phone: 361-593-5223 Email: paactutoring@tamuk.edu Website: PAAC Tutoring Appointments: javsuccess.tamuk.edu IG: tamuksuccess_squad
Writing Center	• Writing consultation in-person and online • Writing consultants assist students with writing assignments at any stage of the writing process: understanding assignments, brainstorming, drafting, revising, editing, researching, and integrating sources	Location: Jernigan Library, 217 Phone: 361-593-2744 Email: success@tamuk.edu Website: Writing Center
Success Peer Mentoring	• Mentors strive to increase students' connections with the university & Kingsville community • Mentors refer students to resources, including experiential learning opportunities (e.g., research, internships, global study, etc.) • Mentors facilitate student success strategies (e.g., time management, motivation, organization, healthy habits, study/test-taking, etc.)	Location: Jernigan Library, 210 & 242 Phone: 361-593-5800 Email: success@tamuk.edu Website: Success Mentoring
Jernigan Library	• Check out books, laptops, calculators, reserve materials and more. (https://libguides.tamuk.edu/access) • LibGuides provides information concerning online research help for a variety of subjects • Computer lab on the first floor • South Texas Archives on the third floor, houses archival materials documenting the rich history of both South Texas and the University	Location: 1050 N. University Blvd. Phone: 361-593-3319 Email: Ask Us! Website: Library

NAME	SERVICES	
Mental Health & Well-Being	• Provide students with essential knowledge and tools to understand and support mental health. • Personal counseling focuses on short-term treatment goals to facilitate adjustment, improve functioning, and address acute symptoms that may impede student success • U-Turn Program helps students identify their academic strengths and opportunities for growth • Next Steps Career Counseling Program assists students who are unsure of their major, career, or future goals/plans • After-hours crisis support through UPD 361.593.2611 • Access to Telus Health, a service available 24/7/365 via chat, phone, or webinar. Scan the QR code to download the app and explore the resources available for guidance and support whenever it is needed.	Location: 1210 N. Retama St. Phone: 361-593-5080 Email: counselingservices@tamuk.edu Website: Counseling Suicide & Crisis Lifeline: call/text 988 Telus app
Disability Resources	• Ensure equal access and full participation in the college experience and programs for students with disabilities • Facilitate reasonable academic accommodations for students on a case-by-case basis that aid in academic success	Location: 1210 N. Retama St. Phone: 361-593-3024 Email: drc.center@tamuk.edu Website: Disability Resource
Advising	• Advisors ensure students stay on track to meet their degree plan needs • Help students set and reach academic and personal career goals • Assists students in finding educational opportunities & campus resources	Location: Various Locations Phone: 361-593-3935 Email: success@tamuk.edu Website: Academic Advising

NAME	SERVICES	
Career Engagement	● Resume reviews & practice interviews ● Strategic career & alumni mentoring connections ● Work study & on-campus job-finding assistance ● Internships & full-time jobs in Javelina Careers powered by Handshake ● Career Expos	Memorial Student Union Building (1050 W. Santa Gertrudis Ave.), 122 (across from Starbucks) Phone: 361-593-2217 Email: hirejavelinas@tamuk.edu Website: Career Engagement